ORIGINAL ARTICLE

POPULATION DYNAMICS IN DABAT HEALTH AND DEMOGRAPHIC SURVEILLANCE SYSTEM SITES, DABAT DISTRICT, NORTHWEST ETHIOPIA: A FOUR-YEAR SERVEILLANCE REPORT (2009 TO 2012)

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ABSTRACT

Introduction*: The Dabat Health and Demographic Surveillance System was launched by the then Gondar College of Medical Sciences in 1996. The main reasons for establishing the surveillance system were to produce demographic and health related evidence in Dabat district and build capacity of the college staff in managing surveillance systems including managing and analyzing longitudinal data. The objective of this report is to describe the population dynamics in Dabat Health and Demographic Surveillance System sites.*

Methods: *A population based surveillance system has continued in Dabat District after conducting re-census in February 2008. Data has been collected by trained data collectors every 6 months. This report includes the analysis of the follow up data from January 01, 2009 to December 31, 2012. Mid-year population counts were reported on June 30 of each year. Data was initially entered using software developed for the DRC purpose and was later migrated to HRS2. STATA was used for data analysis.*

Results: *The population counts were 45369 in 2009, 45815 in 2010, 46178 in 2011, and 47253 in 2012. The Crude Birth Rate (CBR) ranged from 25.2 in 2011 to 30.0 births/1000 population in 2009. Similarly, Total Fertility Rate (TFR) ranged from 3.6 in 2011 to 4.4 in 2009. The Crude Death Rates (CDRs) were 7.6 in 2009, 7.8 in 2010, 5.3 in 2011, and 6.6 per 1000 population in 2012. Infant Mortality Rate (IMR) decreased from 74.2 in 2009 to 60.0 per 1000 live births in 2012. In the same manner, Under-five Mortality Rate (U5MR) decreased from 92.5 in 2009 to 75.8 per 1000 live births in 2012.The net-migration rates were negative in all the surveillance years. Migration rates were high among females in the age group of 20-29 years. The rates of natural increase were 2.2 in 2009 and 201; 2.0 in 2011, and 2.3 per 1000 population in 2012.*

Conclusion*: While the decreases in fertility rates were not remarkable there were substantial reductions in childhood mortality rates. The net external migration rates were negative over the entire surveillance period. The District Health Office and the health institutions in the area with other stakeholders need to maximize their curative, preventive, and promotive health services to significantly reduce the fertility and mortality rates. Further detailed research on reasons for migration, especially out-migration, is also recommended.*

Key words*: Population dynamics; Dabat HDSS; Fertility; Mortality; Migration*

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INTRODUCTION

A Systematic collection of data is required to understand the composition, growth, and movement of the population. Generally, demographic data and estimates are drawn primarily from national censuses, demographic surveys, and vital statistics systems. In Ethiopia, one of the sources of information on demography is the population and housing census. Three censuses were conducted in 1984, 1994 and 2007(1). Additionally, some other surveys were conducted in the country to generate data on demography and health which included the 1981 Demographic Survey, the National Family and Fertility Survey (NFFS) in 1990, and the 3 Demographic and Health Surveys (EDHS) conducted in 2000, 2005, and 2011(2). On top of these, data related to health is generated by health institution-based passive surveillance(3).

In Ethiopia nationwide surveys are not conducted frequently which leads to lack of information about the population between the two surveys. Moreover, there has been no continuous registration of vital events. To fill some of the information gaps related to demography and health, Health and Demographic Surveillance Systems (HDSS) were established by different universities at different corners of the country. The other major purpose of establishing the surveillance systems was to facilitate research undertakings in the respective universities. The established university owned surveillance systems included the Butajira Rural Health Program (BRHP)(4), the Addis Ababa Mortality Surveillance Program (AAMSP) (5), the Dabat Research Center (DRC)(6), the Gilgel Gibe Field Research Center (GGFRC)(7), the Kersa Demographic Surveillance and Health Research Center (KDS-HRC)(8), the Kilite Awlaelo Demographic and Health Surveillance Site (KAD-HDP)(9), and the Arba Minch Zuria Demographic and Health Development Program (AM-DHDP)(10).

The Dabat Research Center (DRC) or the Dabat HDSS was established in 1996 after conducting the first baseline survey. Dabat town, the capital of Dabat District, is located approximately 821 km northwest of Addis Ababa and 75 km north of Gondar town. This surveillance site covers 10 randomly selected kebeles (seven rural and three urban) out of the 32 kebeles in the district. In 2008, the second baseline survey was conducted because there was some change in the kebeles included in the surveillance(6).

The Total population of Ethiopia during the 2007 census was 73.8 million. The male population was slightly higher (50.5%) than the female population (49.5%) at the country level. Similarly, in Amhara Region males constituted 50.2% of the total population. Dabat district had a total population of 145,458 where 73,825 (50.75%) were males(1). Slightly different to this finding, males were found to constitute 49% of the total population included in the surveillance as revealed by the 2008 baseline survey(6). Nationally, the annual growth rates decreased from 3.1% per annum in 1984 to 2.6% in 2007. During the same period the Amhara Region was reported to have the lowest growth rate (1.7% per annum)(1).

The fertility rates were different in different parts of Ethiopia. The Crude Birth Rate (CBR) in the country was 34.5 births per 1,000 population as reported in the 2011 EDHS. Like the other fertility measures, there was a significant difference in the CBR of urban and rural areas. The CBR was higher in rural areas (36 per 1,000 population) than in urban areas (26 per 1,000 population). The General Fertility Rate (GFR) in Ethiopia was 161 live births per 1,000 women aged 15-44 years. This rate was considerably higher in rural areas (184) than in urban areas (89). The fertility among adolescents aged 15-19 was 79 births per 1,000 women in Ethiopia. Fertility peak was observed at age 25-29 in both rural and urban areas. While the Total Fertility Rate (TFR) for the nation was 4.8 during the 2011 EDHS, there were substantial differences among the regions, ranging from 1.5 in Addis Ababa to 7.1 in Somali. The TFR in the Amhara Region was lower than the national average(2). During the 2008 re-census conducted by the Dabat Research center, the CBR of the study area was 27.4 per 1000 population. The GFR and TFR were 118.8 per 1000 women aged 15-49 years, and 4.7 per woman, respectively(6).

Mortality rates in Ethiopia have shown a reduction. Infant Mortality Rate (IMR) and Under Five Mortality Rate (U5MR) are two of the indicators of the 4th MDG which is related to child mortality. The IMR decreased from 77 per 1000 live births in 2005 to 59 per 1000 live births in 2011. Similarly, U5MR decreased from 123 per 1000 live births in 2005 to 88 per 1000 live births in 2011(2). The Crude death rates (CDR) in Dabat HDSS site were 11.7 per 1000 population in 1996 and 5.9 per 1000 population in 2008. During the 2008 re-census, the IMR and U5MR were reported as 39.2 and 57.6 per 1000 live births, respectively(6, 11).

Migration is one of the components of population change. In Ethiopia, the emigration rate seems

greater than the immigration rate. In 2010 the emigration rate was 0.7% and that of the immigration was 0.6%. Most people emigrate to Sudan, the United States, Israel, Djibouti, Kenya, Saudi Arabia, Canada, Germany, Italy, and Sweden. Ethiopia also receives a significant number of immigrants from Eritrea, Somalia, Sudan, Djibouti, and Kenya(12).

The Dabat HDSS was established with the aim of generating continuous demographic and health related information to support evidence based decision-making and enhance the integration of training, service, and research. This report is a special issue which focus on population dynamics.

OBJECTIVES

The objective of this report is to describe the population dynamics of Dabat HDSS sites in Dabat District during the surveillance period from 2009 to 2012.

METHODS

Study design:
A community-based follow up study (surveillance) has been conducted following the baseline survey of 1996 and the re-census of 2008.

Study area:
The surveillance has been conducted in Dabat district which is located in northwest Ethiopia. In 2007, the district had a total population of 145,458, living in 27 rural and 3 urban Kebeles (sub-districts), according to the report of the Central Statistical Agency. The altitude of the district ranges from about 1000 meters to over 2500 meters above sea level. Seven rural and 3 urban kebeles are included in the surveillance(1).

Population under surveillance:
All permanent residents of the selected seven rural and three urban kebeles were enumerated during the 2008 re-census. After the census, births and other pregnancy outcomes, deaths, migrations, and marital status changes have been registered every 6 months regularly during a specified update round time. The data of nine update rounds had been collected until the end of December, 2012.

Selection of kebeles:
During the selection of kebeles, climatic condition was considered in addition to the efforts made to represent both urban and rural kebeles. Accordingly, three climatic conditions namely, highland, midland, and lowland were included in the surveillance. Even though kebeles were designated as highlands, midlands, and lowlands, all of the households in a specific kebele might not have the same climatic condition. After stratifying the kebeles by climatic condition, seven kebeles from the highland, one kebele from the midland, and two kebeles from the lowland were selected randomly. The lowland rural kebeles were Arebur and Bera. Talakmesk was the only rural kebele representing the midland. Benker, Tenseye, Dequa, and Chila were rural kebeles representing the highland. The 3 urban kebeles of Dabat town (kebele 01, 02, and 03) were all highlands(6). The surveillance kebeles are shown in Figure 1.

Data collection:
During each round, data was collected using a semi-structured questionnaire. The update questionnaire included information related to birth and other pregnancy outcomes, death, migration, and marital status change. The Data was collected by 17 trained and full-time field workers who had completed high school and were living in the district. Four supervisors were deployed to supervise the data collection. Interviews were administered to the heads of the households. When the head was not available during the data collection, the next elder family member was interviewed. When data collectors visited the houses during the update rounds, they wrote the name of the individual who migrated on their notebook and waited for 6 months for final registration of his/her migration status on the migration form. This procedure was applied for both internal and external migrations. After waiting for 6 months, the date of migration was registered as the date that individual first entered or left the house. Data quality was maintained by an intensive training of field workers and supervisors, pre-testing of data collection tools, close supervision by resident supervisors and research team members.

Data processing and analysis:
Data completeness was checked by supervisors during data collection and by data clerks and data managers during entry. Incomplete questionnaires were sent back to the site and refilled. Data were initially entered using software developed for the DRC purpose and later migrated to the Household Registration System (HRS2). The data was exported to STATA version 11.0 statistical packages for analysis. This report included analysis of the follow up data from January 01, 2009 to December 31, 2012. The mid-year population counts reported was the population on June 30 in the respective years.

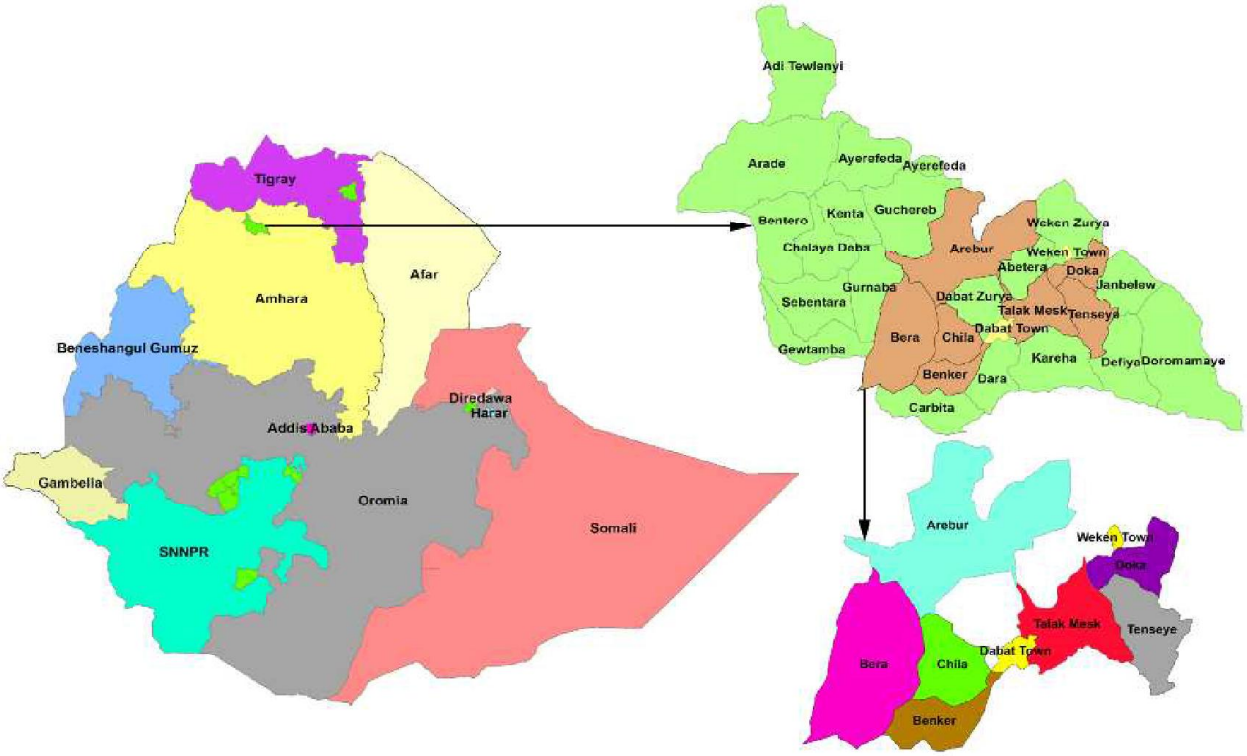

Figure 1: *Map of Ethiopia (left), Dabat district (right top), and Dabat HDSS site (right bottom), 2012*

Operational definitions:

Aged dependency ratio: the ratio of number of people aged 65 years and over to number of people aged 15-64 years.

Child dependency ratio: the ratio of number of people aged 0-14 years to number of people aged 15-64 years.

Child mortality rate: number of deaths of children aged 1 to 4 years in a given year per 1000 live births.

Child-Woman ratio: number of children under age 5 per 1000 women of childbearing age in a given year.

Early neonatal mortality rate: number of deaths of infants during the first seven days of life in a given year per 1,000 live births in the same year.

External in-migration rate: the number of people who entered the Dabat HDSS sites per 1,000 population of the HDSS sites.

External out-migration rate: the number of people departed from Dabat HDSS sites per 1,000 population of the HDSS sites.

General Fertility rate (GFR): the number of live births per 1,000 women aged 15-49 in a given year

Growth Rate: the rate at which a population is increasing (or decreasing) in a given year due to natural increase and net migration, expressed as a percentage of the base population

Highland: altitude of 2,000 to 2500 meters above sea level.

Internal in-migration: is a type of migration where a person comes to a specific household from another household within Dabat HDSS.

Internal in-migration rate: the number of people who entered specific households from other households within the Dabat HDSS per 1000 population of the specific destination sites of the HDSS.

Internal migration: is a type of migration where residence changes from one residential unit to another within Dabat HDSS.

Internal Out-migration: is a type of migration where a person leaves a specific household and moves to another household within Dabat HDSS.

Internal out-migration rate: the number of people who left specific households and moved to other households within Dabat HDSS per 1000 population of the specific sites where these people have been living.

Kebele: the smallest administrative unit of local government in Ethiopia.

Late Neonatal Mortality Rate: number of deaths of infants after 7 days and before 28 days of life in a given year per 1,000 live births in the same year.

Lowland: altitude of less than 1500 meters above sea level

Midland: altitude ranging from 1,500 to 1,999 meters above sea level

Neonatal mortality rate: number of deaths of infants under 28 days of age in a given year per 1,000 live births in the same year.

Net External Migration Rate: the net effect of external in-migration and out-migration on the HDSS site population expressed as increase or decrease per 1000 population of the HDSS site in a given year.
Nonworking-age population: people younger than 15 years and older than 64 years.
Post neonatal mortality rate: number of deaths of infants aged 28 days to 1 year per 1,000 live births in a given year.
Rate of Natural Increase (RNI): the rate at which a population is increasing (or decreasing) in a given year due to a surplus (or deficit) of births over deaths, expressed as a percentage of the base population.
Total dependency ratio: the ratio of nonworking-age to working-age population
Under-five mortality rate: number of deaths of children from birth to 4 years per 1000 live births in a given year.
Very highland: altitude greater than 2500 meters above sea level
Working-age population: people aged 15-64 years

Ethical considerations:
The study protocol was reviewed and approved by the Institutional Review Board of the University of Gondar, Ethiopian Science and Technology Agency through the Ethiopian Public Health Association, and Center for Disease Control and Prevention (CDC). Written permission was obtained from the North Gondar Zonal Health Office and the Dabat District Health Office. Informed verbal consent was secured from the respondents after a full explanation about the surveillance including the purpose of the study. The freedom of each participant to withdraw at any time during the follow up was guaranteed. Data confidentiality was assured by making the data accessible only to the research team and by locking the questionnaire in a box. The information obtained from analysis of the surveillance data was disseminated to people in the surveillance site and other stakeholders by using different strategies, like sending written reports, presenting core findings at meetings, and publishing them in journals.

RESULTS

Population size:
The population counts over the 4 years of surveillance time were 45,369 in 2009, 45,815 in 2010, 46,178 in 2011, and 47,253 in 2012. During the entire surveillance period males constituted about 49.3% of the total population on average. Different sex compositions had been observed at different ages of the population. The percentage of males during the first year of life was 50.9%, 51.6 %, 51.0%, and 51.2%, respectively for the surveillance years of 2009, 2010, 2011, and 2012. The percentage of males decreased at the age of 30-34 years. It was 46.8% in 2009, 46.1% in 2010, 46.0% in 2011, and 44.9% in 2012. On the other hand, males significantly outnumbered the females at the age of 65 years and above where they constituted about 54.6% of the total population on average (Table 1). As shown in Figure 2 & 3, the proportion of under five population decreased in 2009 compared to the proportion in 2012. Out of the total population of the surveillance site, the numbers of rural dwellers were 36,102 (79.6 %), 36,240 (79.1%), 36,332 (78.7%), and 36,629 (77.5%) in 2009, 2010, 2011, and 2012, respectively (Table 2). In the rural kebeles, most people (7,636) lived in Arebur followed by Talak Mesk (5,354) (Table 3). In 2012, a total of 34,857 people (73.8 %) lived in the high land and very highland areas. All the urban kebeles lay in the very highland and highland areas. During the same year, 12,342 people (26.1%) lived in the Midland area. On the contrary, very few (54) lived in the lowland area (Table 4).

The total numbers of women in their reproductive age (15-49 years) were 10,385 (22.9% of the total population) in 2009, 10,544 (23.0%) in 2010, 10,636 (23.0%) in 2011, and 10,967 (23.2%) in 2012. The total number of under five children was 7,330 (16.2%) in 2009, 7,241 (15.8%) in 2010, 6,863 (14.9%) in 2011, and 6,754 (14.3%) in 2012. The under 15 year old population was 20,524 (45.2%) in 2009, 20573 (44.9%) in 2010, 20282(43.9%) in 2011, and 20577 (43.5 %) in 2012. In each year, the numbers of the working age population were 23282, 23657, 24206, and 24970 in 2009, 2010, 2011, and 2012, respectively. While the old age dependency ratio slightly increased from 6.7% in 2009 to 6.8% in 2012, child dependency ratio decreased from 88.2% in 2009 to 82.4% in 2012. The maximum total dependency ratio was seen in 2009 (94.9%) and the minimum in 2012 (89.2%) (Table 5).

The total number of households in 2009 was 9890 of which 2631 lived in urban and 7259 in rural surveillance sites. The number of households in 2012 increased to 10,594 when 3134 were in urban and 7460 in rural areas. The average family size in the surveillance sites slightly decreased from 4.6 in 2009 to 4.5 in 2012. However, there were differences between rural and urban dwellers in terms of family size. In 2009, the rural dwellers' average family size was 5.0 while it was 3.5 in urban areas. Similar differences were also observed in the remaining years (Table 6).

Table 1: Population by year, sex, and age, Dabat HDSS site, December 2012

Age group	2009*			2010*			2011*			2012*		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
<1	610	588	1,198	739	692	1,431	577	555	1,132	678	647	1,325
1-4	3,065	3,067	6,132	2,942	2,868	5,810	2,918	2,813	5,731	2,753	2,676	5,429
5-9	3,311	3,204	6,515	3,436	3,430	6,866	3,421	3,447	6,868	3,613	3,612	7,225
10-14	3,346	3,333	6,679	3,239	3,227	6,466	3,322	3,229	6,551	3,335	3,263	6,598
15-19	2,768	2,905	5,673	2,822	2,893	5,715	2,827	2,795	5,622	2,925	2,807	5,732
20-24	1,896	1,928	3,824	1,897	2,011	3,908	1,995	2,043	4,038	2,019	2,122	4,141
25-29	1,266	1,600	2,866	1,312	1,577	2,889	1,327	1,579	2,906	1,439	1,672	3,111
30-34	1,120	1,275	2,395	1,138	1,330	2,468	1,227	1,438	2,665	1,235	1,516	2,751
35-39	1,060	1,190	2,250	1,061	1,229	2,290	1,006	1,207	2,213	1,025	1,204	2,229
40-44	867	774	1,641	892	817	1,709	974	958	1,932	1,048	1,060	2,108
45-49	680	713	1,393	680	687	1,367	680	616	1,296	696	586	1,282
50-54	623	768	1,391	645	798	1,443	708	912	1,620	696	925	1,621
55-59	440	520	960	445	517	962	411	461	872	448	481	929
60-64	436	453	889	426	480	906	475	567	1,042	487	579	1,066
65+	849	714	1,563	870	715	1,585	927	763	1,690	925	781	1,706
Total	**22,337**	**23,032**	**45,369**	**22,544**	**23,271**	**45,815**	**22,795**	**23,383**	**46,178**	**23,322**	**23,931**	**47,253**

** Mia-year populationon June 30*

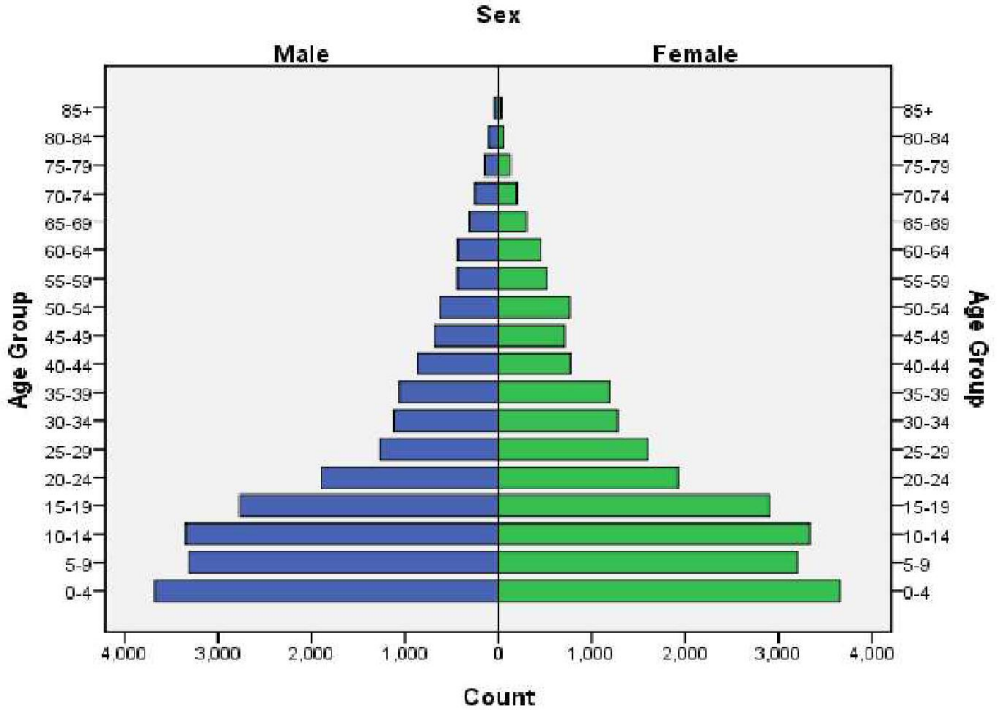

Figure 2: *Population pyramid of Dabat HDSS site, 2009*

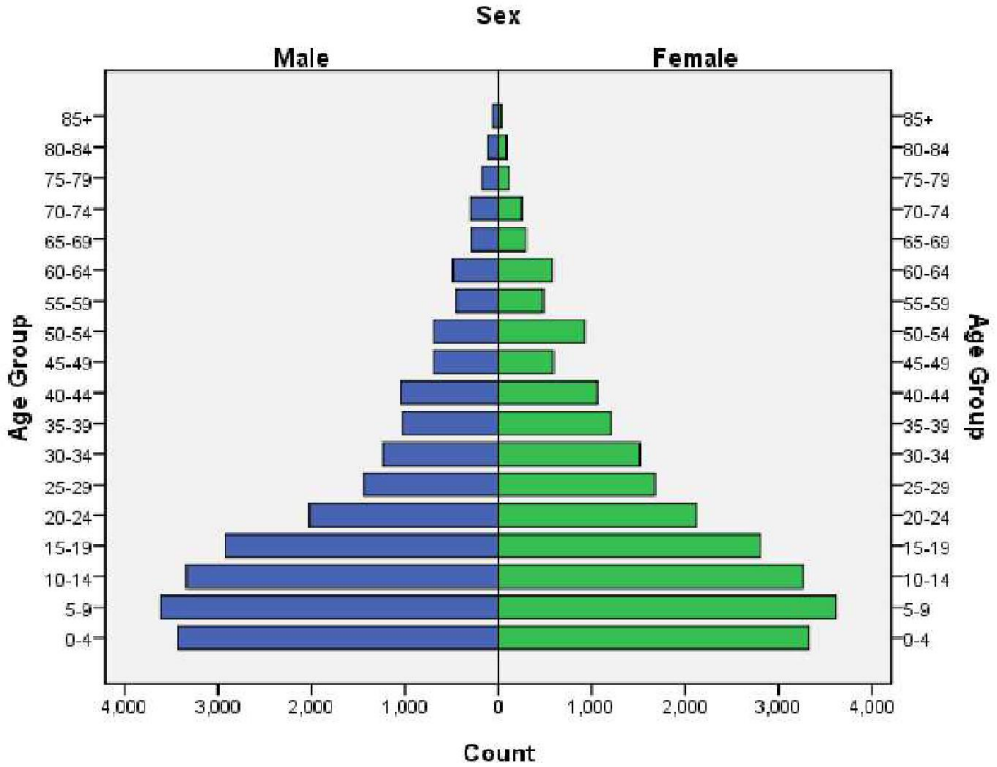

Figure 3: *Population pyramid of Dabat HDSS site, 2012*

Table 2: Population by year, residence and age, Dabat HDSS site, December 2012

Age group	2009*			2010*			2011*			2012*		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
<1	215	983	1,198	217	1,214	1,431	213	919	1,132	264	1,061	1,325
1-4	958	5,174	6,132	960	4,850	5,810	962	4,769	5,731	1,017	4,412	5,429
5-9	1,045	5,470	6,515	1,161	5,705	6,866	1,219	5,649	6,868	1,275	5,950	7,225
10-14	1,251	5,428	6,679	1,195	5,271	6,466	1,156	5,395	6,551	1,214	5,384	6,598
15-19	1,324	4,349	5,673	1,328	4,387	5,715	1,259	4,363	5,622	1,301	4,431	5,732
20-24	809	3,015	3,824	863	3,045	3,908	939	3,099	4,038	1,072	3,069	4,141
25-29	677	2,189	2,866	735	2,154	2,889	803	2,103	2,906	974	2,137	3,111
30-34	563	1,832	2,395	618	1,850	2,468	670	1,995	2,665	717	2,034	2,751
35-39	543	1,707	2,250	561	1,729	2,290	563	1,650	2,213	605	1,624	2,229
40-44	392	1,249	1,641	411	1,298	1,709	470	1,462	1,932	528	1,580	2,108
45-49	323	1,070	1,393	316	1,051	1,367	296	1,000	1,296	301	981	1,282
50-54	306	1,085	1,391	329	1,114	1,443	380	1,240	1,620	385	1,236	1,621
55-59	242	718	960	236	726	962	205	667	872	226	703	929
60-64	222	667	889	238	668	906	286	756	1,042	301	765	1,066
65+	397	1,166	1,563	407	1,178	1,585	425	1,265	1,690	444	1,262	1,706
Total	**9,267**	**36,102**	**45,369**	**9,575**	**36,240**	**45,815**	**9,846**	**36,332**	**46,178**	**10,624**	**36,629**	**47,253**

* Mid-year population on June 30

Table 3: Population by year, sex and Kebele, Dabat HDSS, December 2012

Residence		2009*			2010*			2011*			2012*		
		Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
Urban (Dabat town)	Kebele 01	883	1,304	2,187	927	1,347	2,274	875	1,326	2,201	959	1,432	2,391
	Kebele 02	1,983	2,500	4,483	2,088	2,584	4,672	2,263	2,751	5,014	2,442	3,005	5,447
	Kebele 03	1,111	1,486	2,597	1,097	1,532	2,629	1,094	1,537	2,631	1,171	1,615	2,786
Urban total		**3,977**	**5,290**	**9,267**	**4,112**	**5,463**	**9,575**	**4,232**	**5,614**	**9,846**	**4572**	**6052**	**10624**
Rural	Arebur	3,915	3,721	7,636	3,913	3,748	7,661	4,016	3,850	7,866	4,105	3,980	8,085
	Benker	2,411	2,328	4,739	2,398	2,341	4,739	2,386	2,329	4,715	2,401	2,307	4,708
	Bera	2,326	2,311	4,637	2,347	2,302	4,649	2,396	2,330	4,726	2,469	2,359	4,828
	Chila	2,247	2,282	4,529	2,258	2,257	4,515	2,251	2,236	4,487	2,257	2,218	4,475
	Dequa	2,464	2,379	4,843	2,464	2,366	4,830	2,471	2,302	4,773	2,448	2,260	4,708
	Talak-mesk	2,770	2,584	5,354	2,806	2,632	5,438	2,791	2,611	5,402	2,810	2,629	5,439
	Tenseye	2,227	2,137	4,364	2,246	2,162	4,408	2,252	2,111	4,363	2,260	2,126	4,386
Rural total		**18,360**	**17,742**	**36,102**	**18,432**	**17,808**	**36,240**	**18,563**	**17,769**	**36,332**	**18,750**	**17,879**	**36,629**
Urban + Rural		**22,337**	**23,032**	**45,369**	**22,544**	**23,271**	**45,815**	**22,795**	**23,383**	**46,178**	**23,322**	**23,931**	**47,253**

** Mia-year populationon June 30*

Table 4: Population by year, sex and altitude, Dabat HDSS sites, December 2012

Residence	Altitude	2009*			2010*			2011*			2012*		
		Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Fe-male**	**Total**	**Male**	**Female**	**Total**
Urban (Dabat town)	Very highland	3,972	5,284	9,256	4,107	5,457	9,564	4,226	5,606	9,832	4,567	6,045	10,612
	Highland	5	6	11	5	6	11	6	8	14	5	7	12
Urban total		**3,977**	**5,290**	**9,267**	**4,112**	**5,463**	**9,575**	**4,232**	**5,614**	**9,846**	**4,572**	**6,052**	**10,624**
Rural	Very highland	11,809	11,429	23,238	11,856	11,473	23,329	11,838	11,317	23,155	11,860	11,275	23,135
	Highland	527	532	1,059	537	543	1,080	545	542	1,087	545	553	1,098
	midland	5,995	5,750	11,745	6,011	5,764	11,775	6,152	5,880	12,032	6,317	6,025	12,342
	lowland	29	31	60	28	28	56	28	30	58	28	26	54
Rural total		**18,360**	**17,742**	**36,102**	**18,432**	**17,808**	**36,240**	**18,563**	**17,769**	**36,332**	**18,750**	**17,879**	**36,629**
Urban + Rural total	Very highland	15,781	16,713	32,494	15,963	16,930	32,893	16,064	16,923	32,987	16,427	17,320	33,747
	Highland	532	538	1070	542	549	1091	551	550	1101	550	560	1110
	midland	5,995	5,750	11,745	6,011	5,764	11,775	6,152	5,880	12,032	6,317	6,025	12,342
	lowland	29	31	60	28	28	56	28	30	58	28	26	54
	Total	**22,337**	**23,032**	**45,369**	**22,544**	**23,271**	**45,815**	**22,795**	**23,383**	**46,178**	**23,322**	**23,931**	**47,253**

** Mia-year populationon June 30*

Table 5: Population sizes for some population groups and dependency ratios, Dabat HDSS site, December 2012

Population group/ Ratio	2009*			2010*			2011*			2012*		
	Number	% of total pop	Ratio	Number	% of total pop	Ratio	Number	% of total pop	Ratio	Number	% of total pop	Ratio
<1 year	1,198	2.6	-	1,431	3.1	-	1,132	2.5	-	1,325	2.8	-
<5 years	7,330	16.2	-	7,241	15.8	-	6,863	14.9	-	6,754	14.3	-
<15 years	20,524	45.2	-	20,573	44.9	-	20,282	43.9	-	20,577	43.5	-
15-64 years (Working age group)	23,282	51.3	-	23,657	51.6	-	24,206	52.4	-	24,970	52.8	-
Women 15-49	10,385	22.9	-	10,544	23.0	-	10,636	23.0	-	10,967	23.2	-
65+	1,563	3.4	-	1,585	3.5	-	1,690	3.7	-	1,706	3.6	-
Dependent age group (<15 and 65+ years	22,087	48.7	-	22,158	48.4	-	21,972	47.6	-	22,283	47.2	-
Child dependency ratio	-	-	88.2	-	-	87.0	-	-	83.8	-	-	82.4
Old age dependency ratio	-	-	6.7	-	-	6.7	-	-	7.0	-	-	6.8
Total dependency ratio	**-**	**-**	**94.9**	**-**	**-**	**93.7**	**-**	**-**	**90.8**	**-**	**-**	**89.2**

** Mid-year population on June 30*

Table 6: Number of households and average family size by year and residence, Dabat HDSS site, December 2012

Residence		2009			2010			2011			2012		
		No. of peo-ple*	No. of House-holds	Average Family size	No. of peo-ple*	No. of House holds	Aver-age Family size	No. of peo-ple*	No. of House-holds	Aver-age Family size	No. of peo-ple*	No. of House-holds	Aver-age Family size
Urban (Dabat town)	Kebele 01	2187	637	3.4	2274	694	3.3	2201	668	3.3	2391	716	3.3
	Kebele 02	4483	1207	3.7	4672	1264	3.7	5014	1351	3.7	5447	1537	3.5
	Kebele 03	2597	787	3.3	2629	805	3.3	2631	827	3.2	2786	881	3.2
Urban total		**9267**	**2631**	**3.5**	**9575**	**2763**	**3.5**	**9846**	**2846**	**3.5**	**10624**	**3134**	**3.4**
Rural	Arebur	7636	1569	4.9	7661	1526	5.0	7866	1558	5.0	8085	1641	4.9
	Benker	4739	965	4.9	4739	966	4.9	4715	973	4.8	4708	981	4.8
	Bera	4637	939	4.9	4649	937	5.0	4726	950	5.0	4828	961	5.0
	Chila	4529	922	4.9	4515	930	4.9	4487	925	4.9	4475	935	4.8
	Dequa	4843	960	5.0	4830	954	5.1	4773	963	5.0	4708	973	4.8
	Talak mesk	5354	1042	5.1	5438	1037	5.2	5402	1049	5.1	5439	1064	5.1
	Tenseye	4364	862	5.1	4408	864	5.1	4363	880	5.0	4386	905	4.8
Rural total		**36102**	**7259**	**5.0**	**36240**	**7214**	**5.0**	**36332**	**7298**	**5.0**	**36629**	**7460**	**4.9**
Urban + Rural		**45369**	**9890**	**4.6**	**45815**	**9977**	**4.6**	**46178**	**10144**	**4.6**	**47253**	**10594**	**4.5**

** Mia-year populationon June 30*

Fertility:

The Crude Birth Rates of the area were 30.0 in 2009, 29.6 in 2010, 25.2 in 2011, and 29.6 per 1,000 population in 2012. The Child-Woman ration decreased from 705.8 per 1000 women of childbearing age in 2009 to 715.8 in 2012 (Table 7). When the entire 4 years period is considered, the CBR was 28.5 per 1000 women years (Table 8). The minimum CBR in urban areas was 19.0 per 1,000 population in 2011 and the maximum was 25.3 per 1,000 population in 2012. In Rural areas, the minimum CBR was 26.9 per 1,000 population in 2011 and the maximum CBR was 32.2 per 1,000 population in 2009 (Table 9). The Age Specific Fertility Rate (ASFR) among adolescents of age 15-19 years decreased from 81.6 per 1,000 in 2009 to 72.3 per 1,000 in 2012. The ASFR reached its peak in the age interval of 25-29 in all the years, except in 2012 in which the peak was in the interval of 30-34 years. For the year 2009 alone, the ASFR increased from 81.6 births per 1,000 women in the age interval of 15-19 to 197.5 births per 1,000 women in the age interval of 25-29, and then declined to 47.7 births among women aged 45-49 years. In the year 2012, the ASFR started to increase from 72.3 births per 1,000 women in the age interval of 15-19 and reached 198.5 births per 1,000 women in the age interval of 30-34 years, and then fell to 17.1 births among women aged 45-49. Age Specific Fertility Rates were higher in rural areas compared to urban areas in all age groups. In 2009, the ASFR among adolescents in the age interval of 15-19 years was 48.7 and 93.2 for urban and rural residence, respectively. In 2012, this rate decreased to 32.1 for urban areas and 86.9 for rural areas (Table 9).

The Total Fertility Rate (TFR) for the study area was 4.4 in 2009, 4.2 in 2010, 3.6 in 2011 and 4.2 in 2012. The TFR in rural areas exceeded the TFR in urban areas for each of the follow up years. In urban areas, the TFR slightly increased from 2.3 in 2009 to 2.5 in 2012. To the contrary, in rural areas, the TFR slightly decreased from 5.2 in 2009 to 4.9 in 2012. During the study years, the General Fertility Rate (GFR) decreased from 131.2 live births per 1,000 women of reproductive age in 2009 to 127.6 live births per 1,000 women of reproductive age in 2012 (Table 9). Considering the entire four-year period from 2009 to 2012, the TFR of the urban areas was 2.2 while the rural areas had a TFR of 4.5. The TFR for the whole surveillance site was 3.8 (Table 10).

Table 7: Fertility rates (per 1000 mid-year women population) by year, Dabat HDSS site, December 2012

Age group	2009			2010			2011			2012		
	No. of women*	No. of Births	ASFR	No. of women*	No. of Births	ASFR	No. of women*	No. of Births	ASFR	No. of women*	No. of Births	ASFR
15-19	2,905	237	81.6	2,893	242	83.7	2,795	165	59.0	2,807	203	72.3
20-24	1,928	314	162.9	2,011	337	167.6	2,043	285	139.5	2,122	344	162.1
25-29	1,600	316	197.5	1,577	312	197.8	1,579	281	178.0	1,672	322	192.6
30-34	1,275	228	178.8	1,330	246	185.0	1,438	237	164.8	1,516	301	198.5
35-39	1,190	190	159.7	1,229	163	132.6	1,207	133	110.2	1,204	158	131.2
40-44	774	43	55.6	817	36	44.1	958	52	54.3	1,060	61	57.5
45-49	713	34	47.7	687	22	32.0	616	12	19.5	586	10	17.1
GFR	-	-	131.2	-	-	128.8	-	-	109.5	-	-	127.6
TFR	-	-	4.4	-	-	4.2	-	-	3.6	-	-	4.2
CBR	-	-	30.0	-	-	29.6	-	-	25.2	-	-	29.6
Child-woman ratio**	-	-	705.8	-	-	686.7	-	-	645.3	-	-	615.8

** Mid-year population on June 30*
***per 1000 women of childbearing age*

Table 8: Fertility rates (per 1000 women years), Dabat HDSS site, December 2012

Age group	2009-2012		
	Women years	No. of births	ASFR
15-19	12821.4	847	66.1
20-24	9239.5	1280	138.5
25-29	6617.6	1231	186.0
30-34	5994	1012	168.8
35-39	4908.8	644	131.2
40-44	4334.8	192	44.3
45-49	2465.8	78	31.6
GFR	-	-	113.9
TFR	-	-	3.8
CBR	-	-	28.5

Table 9: Fertility rates (per 1000 mid-year women population) by year and residence, Dabat HDSS site, December 2012

Age group	2009			2010			2011			2012		
	ASFR Urban	ASFR Rural	ASFR U+R	ASFR Urban	ASFR Rural	ASFR U+R	ASFR Urban	ASFR Rural	ASFR U+R	ASFR Urban	ASFR Rural	ASFR U+R
15-19	48.7	93.2	81.6	46.5	96.7	83.7	26.8	70.0	59.0	32.1	86.9	72.3
20-24	97.6	185.8	162.9	126.2	182.7	167.6	94.2	157.6	139.5	113.7	185.2	162.1
25-29	144.5	216.5	197.5	130.4	225.6	197.8	114.4	208.0	178.0	147.4	217.7	192.6
30-34	77.8	214.7	178.8	114.8	211.6	185.0	90.2	192.4	164.8	117.4	230.3	198.5
35-39	61.3	196.8	159.7	63.8	157.8	132.6	42.3	135.8	110.2	68.0	155.9	131.2
40-44	18.6	69.8	55.6	21.3	53.3	44.1	17.9	69.2	54.3	12.9	76.0	57.5
45-49	10.9	60.5	47.7	16.8	37.4	32.0	6.0	24.5	19.5	12.0	19.1	17.1
GFR	72.6	152.2	131.2	81.8	146.3	128.8	63.1	127.5	109.5	82.2	146.8	127.6
TFR	2.3	5.2	4.4	2.6	4.8	4.2	2.0	4.3	3.6	2.5	4.9	4.2
CBR	21.5	32.2	30.0	24.4	31.0	29.6	19.0	26.9	25.2	25.3	30.8	29.6

Table 10: Fertility rates (Per 1000 women years) by residence, Dabat HDSS site, December 2012

Age group	2009-2012								
	Urban			Rural			Total		
	Women years	No. of births	ASFR	Women years	No. of births	ASFR	Women years	No. of births	ASFR
15-19	3045.4	115	37.8	9776	732	74.9	12821.4	847	66.1
20-24	2556	250	97.8	6683.5	1030	154.1	9239.5	1280	138.5
25-29	2098.1	267	127.3	4519.5	964	213.3	6617.6	1231	186.0
30-34	1658.2	153	92.3	4335.9	859	198.1	5994.1	1012	168.8
35-39	1308.9	78	59.6	3600	566	157.2	4908.9	644	131.2
40-44	1253.1	18	14.4	3081.6	174	56.5	4334.7	192	44.3
45-49	705.2	8	11.3	1760.6	70	39.8	2465.8	78	31.6
Total	12624.9	889	70.4	33757.1	4395	130.2	46382	5284	113.9
GFR	-	-	70.4	-	-	130.2	-	-	113.9
TFR	-	-	2.2	-	-	4.5	-	-	3.8
CBR	-	-	22.4	-	-	30.2	-	-	28.5

Mortality:

The crude death rate for the period 2009 to 2012 was 6.8 per 1000 person years. High Age Specific Mortality Rates (ASMRs) were observed in children of under- five years (26.8 per 1000 person years) and people aged 65 years and above (40.3 per 1000 person years) (Table 11). In each surveillance year, the highest crude death rate was observed in 2010 (7.8 per 1000 population) and the lowest was for the year 2011 (5.3 per 1000 population) (Table 12). The lowest ASMR was observed among 5-9 and 10-14 years age groups. The ASMRs for the age group of 10-14 years were 1.3 per 1000 population in 2009 and 0.8 per 1000 in 2012 (Table 12). In general, the CDR rate was higher for males than females except in 2011. Among males, the CDRs were 8.1 per 1000 population in 2009, 7.9 per 1000 in 2010, 5.0 per 1000 in 2011, and 7.4 per 1000 in 2012, while for females it was 7.2 per 1000 population in 2009, 7.7 per 1000 in 2010, 5.6 per 1000 in 2011, and 5.9 per 1000 in 2012 (Table 13). Also during the entire four-year period, males had higher CDR (7.1 per 1000 person years) compared to females (6.5 per 1000 person years) (Table 14).

Crude Death Rates were higher in urban areas in 2009 and 2010 but in 2011 and 2012 mortality rates in rural areas slightly surpassed the mortalities in urban areas. In 2009 the CDRs in urban and rural areas were 9.9 per 1000 population and 7.1 per 1000 respectively. When the death rates during the last surveillance year were compared, the CDR in urban areas was 6.5 per 1000 population and in rural areas it was 6.7 per 1000 population (Table 15). During the entire four years, urban areas had higher CDR (7.3 per 1000 person years) compared to rural areas (6.7 per 1000 person years) (Table 16).

During the entire period from 2009 to 2012, the average Early Neonatal, Neonatal, Infant, and Under-five mortality rates were 24.2, 35.2, 63.6 and 83.8 per 1000 live births, respectively. The IMR decreased from 74.2 in 2009 to 60.0 per 1000 live births in 2012. Similarly the under-five mortality rate decreased from 92.5 in 2009 to 75.8 in 2012 (Table 17). Even though some variations were seen from year to year, when the entire 4 years period is considered, all the childhood mortality rates were higher in rural areas. In the urban areas, the average ENMR, NMR, IMR, and U5MR were 21.4, 27.0, 48.4, and 63.0 per 1000 live births, respectively. In the rural areas, the average ENMR, NMR, IMR, and U5MR were 24.8, 36.9, 66.7, and 88.1 per 1000 live births, respectively (Table 18). During the entire four years ENMR, NMR, IMR, and U5MR were higher in highland areas compared to midland areas. In the highland areas, ENMR, NMR, IMR, and U5MR were 27.4, 38.0, 71.9, 92.2 per 1000 live births, respectively. On the other hand, in the midland areas ENMR, NMR, IMR, and U5MR were 17.2, 28.9, 44.8, 65.1 per 1000 live births, respectively. While the CDR remained at 5.6 in midland areas between 2009 and 2012, it decreased from 8.4 to 7.0 in highland areas between 2009 and 2012 (Table 19).

Table 11: Age Specific Mortality Rates (per 1000 person years) for the entire period 2009-2012, Dabat HDSS, December 2012

Age group	Person years	No of deaths	ASMR
0-4	16528.7	443	26.8
5-9	29457	30	1
10-14	26516.4	23	0.9
15-19	25619.7	41	1.6
20-24	18572.5	47	2.5
25-29	12554.9	47	3.7
30-49	33835.4	146	4.3
50-64	14606.8	172	11.8
65+	7774.1	313	40.3
Total	**185465.6**	**1262**	**6.8**
CDR	-	-	**6.8**

Table 12: Age Specific Mortality Rates (per 1000 mid-year population) by year, Dabat HDSS, December 2012

Age group	2009			2010			2011			2012		
	No. of people*	No deaths	ASMR	No. of people*	No deaths	ASMR	No. of people*	No deaths	ASMR	No. of people*	No deaths	ASMR
0-4	7,330	126	17.2	7,241	131	18.1	6,863	80	11.7	6,754	106	15.7
5-9	6,515	8	1.2	6,866	9	1.3	6,868	7	1.0	7,225	6	0.8
10-14	6,679	9	1.3	6,466	4	0.6	6,551	5	0.8	6,598	5	0.8
15-19	5,673	9	1.6	5,715	12	2.1	5,622	12	2.1	5,732	8	1.4
20-24	3,824	11	2.9	3,908	16	4.1	4,038	8	2.0	4,141	13	3.1
25-29	2,866	12	4.2	2,889	19	6.6	2,906	10	3.4	3,111	6	1.9
30-49	7,679	43	5.6	7,834	44	5.6	8,106	26	3.2	8,370	33	3.9
50-64	3,240	57	17.6	3,311	44	13.3	3,534	30	8.5	3,616	41	11.3
65+	1,563	72	46.1	1,585	77	48.6	1,690	69	40.8	1,706	95	55.7
Total	**45,369**	**347**	**7.6**	**45,815**	**356**	**7.8**	**46,178**	**247**	**5.3**	**47,253**	**313**	**6.6**
CDR			**7.6**			**7.8**			**5.3**			**6.6**

** Mia-year populationon June 30*

Table 13: Age specific Mortality rates by year and sex (per 1000 mid-year population), Dabat HDSS, December 2012

Age group	2009						2010						2011						2012					
	Male			Female			Male			Female			Male			Female			Male			Female		
	MYP*	Death	ASMR	MYP*	Death	ASMR	MYP*	Death	ASMR	MYP*	Death	ASMR	MYP*	Death	ASMR	MYP*	Death	ASMR	MYP*	Death	ASMR	MYP*	Death	ASMR
0-4	3,675	69	18.8	3,655	57	15.6	3,681	76	20.6	3,560	55	15.4	3,495	42	12.0	3,368	38	11.3	3,431	66	19.2	3,323	40	12.0
5-9	3,311	4	1.2	3,204	4	1.2	3,436	5	1.5	3,430	4	1.2	3,421	5	1.5	3,447	2	0.6	3,613	2	0.6	3,612	4	1.1
10-14	3,346	7	2.1	3,333	2	0.6	3,239	4	1.2	3,227	0	0.0	3,322	2	0.6	3,229	3	0.9	3,335	2	0.6	3,263	3	0.9
15-19	2,768	6	2.2	2,905	3	1.0	2,822	3	1.1	2,893	9	3.1	2,827	6	2.1	2,795	6	2.1	2,925	6	2.1	2,807	2	0.7
20-24	1,896	4	2.1	1,928	7	3.6	1,897	9	4.7	2,011	7	3.5	1,995	3	1.5	2,043	5	2.4	2,019	8	4.0	2,122	5	2.4
25-29	1,266	5	3.9	1,600	7	4.4	1,312	4	3.0	1,577	15	9.5	1,327	5	3.8	1,579	5	3.2	1,439	3	2.1	1,672	3	1.8
30-49	3,727	18	4.8	3,952	25	6.3	3,771	23	6.1	4,063	21	5.2	3,887	11	2.8	4,219	15	3.6	4,004	20	5.0	4,366	13	3.0
50-64	1,499	32	21.3	1,741	25	14.4	1,516	15	9.9	1,795	29	16.2	1,594	13	8.2	1,940	17	8.8	1,631	19	11.6	1,985	22	11.1
65+	849	37	43.6	714	35	49.0	870	38	43.7	715	39	54.5	927	28	30.2	763	41	53.7	925	46	49.7	781	49	62.7
Total	**22,337**	**182**	**8.1**	**23,032**	**165**	**7.2**	**22,544**	**177**	**7.9**	**23,271**	**179**	**7.7**	**22,795**	**115**	**5.0**	**23,383**	**132**	**5.6**	**23,322**	**172**	**7.4**	**23,931**	**141**	**5.9**
CDR			**8.1**			**7.2**			**7.9**			**7.7**			**5.0**			**5.6**			**7.4**			**5.9**

** Mia-year populationon June 30*
MYP = Mid Year Populatio

Table 14: Age specific Mortality rates (per 1000 person years) by sex for the entire period 2009-2012, Dabat HDSS, December 2012

Age group	Male			Female		
	Person years	Death	ASMR	Person years	Death	ASMR
0-4	8418	253	30.1	8110.7	190	23.4
5-9	14714.6	16	1.1	14742.4	14	0.9
10-14	13283.9	15	1.1	13232.5	8	0.6
15-19	12798.3	21	1.6	12821.4	20	1.6
20-24	9333	24	2.6	9239.5	23	2.5
25-29	5937.3	17	2.9	6617.6	30	4.5
30-49	16132.1	72	4.5	17703.4	74	4.2
50-64	6587.7	79	12	8019.1	93	11.6
65+	4193.6	149	35.5	3580.5	164	45.8
Total	**91398.5**	**646**	**7.1**	**94067**	**616**	**6.5**
CDR			**7.1**			**6.5**

** Mid-year population on June 30*
MYP = Mid Year Population

Table 15: Age specific Mortality rates (per 1000 midyear population) by year and residence, Dabat HDSS, December 2012

Age group	2009						2010						2011						2012					
	Urban			Rural			Urban			Rural			Urban			Rural			Urban			Rural		
	MYP *	Death	ASMR	MYP *	Death	ASMR	MYP *	Death	ASMR	MYP *	Death	ASMR	MYP *	Death	ASMR	MYP *	Death	ASMR	MYP *	Death	ASMR	MYP *	Death	ASMR
0-4	1,173	17	14.5	6,157	109	17.7	1,177	12	10.2	6,064	119	19.6	1,175	9	7.7	5,688	71	12.5	1,281	18	14.1	5,473	88	16.1
5-9	1,045	1	1.0	5,470	7	1.3	1,161	0	0.0	5,705	9	1.6	1,219	0	0.0	5,649	7	1.2	1,275	0	0.0	5,950	6	1.0
10-14	1,251	1	0.8	5,428	8	1.5	1,195	0	0.0	5,271	4	0.8	1,156	0	0.0	5,395	5	0.9	1,214	1	0.8	5,384	4	0.7
15-19	1,324	2	1.5	4,349	7	1.6	1,328	0	0.0	4,387	12	2.7	1,259	3	2.4	4,363	9	2.1	1,301	0	0.0	4,431	8	1.8
20-24	809	5	6.2	3,015	6	2.0	863	2	2.3	3,045	14	4.6	939	2	2.1	3,099	6	1.9	1,072	2	1.9	3,069	11	3.6
25-29	677	6	8.9	2,189	6	2.7	735	8	10.9	2,154	11	5.1	803	3	3.7	2,103	7	3.3	974	1	1.0	2,137	5	2.3
30-49	1,821	14	7.7	5,858	29	5.0	1,906	19	10.0	5,928	25	4.2	1,999	8	4.0	6,107	18	2.9	2,151	15	7.0	6,219	18	2.9
50-64	770	21	27.3	2,470	36	14.6	803	14	17.4	2,508	30	12.0	871	7	8.0	2,663	23	8.6	912	14	15.4	2,704	27	10.0
65+	397	25	63.0	1,166	47	40.3	407	25	61.4	1,178	52	44.1	425	18	42.4	1,265	51	40.3	444	18	40.5	1,262	77	61.0
Total	**9,267**	**92**	**9.9**	**36,102**	**255**	**7.1**	**9,575**	**80**	**8.4**	**36,240**	**276**	**7.6**	**9,846**	**50**	**5.1**	**36,332**	**197**	**5.4**	**10,624**	**69**	**6.5**	**36,629**	**244**	**6.7**
CDR			**9.9**			**7.1**			**8.4**			**7.6**			**5.1**			**5.4**			**6.5**			**6.7**

** Mid-year population on June 30*

MYP = Mid Year Population

Table 16: Age specific Mortality rates (per 1000 person years) by residence for the entire period 2009-2012, Dabat HDSS, December 2012

Age group	Urban			Rural		
	Person years	Death	ASMR	Person years	Death	ASMR
0-4	2981.3	56	18.8	13547.4	387	28.6
5-9	5014.3	1	0.2	24442.8	29	1.2
10-14	4603.1	2	0.4	21913.3	21	1
15-19	5569.1	5	0.9	20050.6	36	1.8
20-24	4202.4	10	2.4	14370.1	37	2.6
25-29	3366.6	18	5.3	9188.3	29	3.2
30-49	8442.7	56	6.6	25392.8	90	3.5
50-64	3544.4	56	15.8	11062.3	116	10.5
65+	1971.1	86	43.6	5803	227	39.1
Total	39695.1	290	7.3	145770.5	972	6.7
CDR			7.3			6.7

Table 17: Key mortality indicators by year, Dabat HDSS site, December 2012

Mortality indicator	2009			2010			2011			2012			2009-2012		
	Live births	Deaths	Mortality rate*	Live births	Deaths	Mortality rate*	Live births	Deaths	Mortality rate*	Live births	Deaths	Mortality rate*	Live births	Deaths	Mortality rate*
ENMR	1362	43	31.6	1358	31	22.8	1,165	12	10.3	1,399	42	30.0	5,284	128	24.2
LNMR	1362	13	9.5	1358	20	14.7	1,165	11	9.4	1,399	14	10.0	5,284	58	11.0
NMR	1362	56	41.1	1358	51	37.6	1,165	23	19.7	1,399	56	40.0	5,284	186	35.2
PNMR	1362	45	33.0	1358	47	34.6	1,165	30	25.8	1,399	28	20.0	5,284	150	28.4
IMR	1362	101	74.2	1358	98	72.2	1,165	53	45.5	1,399	84	60.0	5,284	336	63.6
CMR	1362	25	18.4	1358	33	24.3	1,165	27	23.2	1,399	22	15.7	5,284	107	20.2
U5MR	1362	126	92.5	1358	131	96.5	1,165	80	68.7	1,399	106	75.8	5,284	443	83.8
CDR			7.6			7.8			5.3			6.6			

** Per 1000 population for CDR & per 1000 live births for other indicators*

***ENMR** = Early Neonatal Mortality Rate, **NMR** = Neonatal Mortality Rate, **PNMR** = Post Neonatal Mortality Rate, IMR = Infant Mortality Rate, CMR = Child Mortality Rate, U5MR = Under Five Mortality Rate, CDR = Crude Death Rate*

Table 18: Key mortality indicators (per 1000) by year and residence, Dabat HDSS site, December 2012

Mortality indicator*	2009			2010			2011			2012			2009-2012		
	U	R	U+R	U	R	U+R	U	R	U+R	U	R	U+R	U	R	U+R
ENMR	20.1	33.5	31.6	29.9	21.4	22.8	0.0	12.3	10.3	29.7	30.1	30.0	21.4	24.8	24.2
LNMR	5.0	10.3	9.5	4.3	16.9	14.7	5.3	10.2	9.4	7.4	10.6	10.0	5.6	12.1	11.0
NMR	25.1	43.9	41.1	34.2	38.3	37.6	5.3	22.5	19.7	37.2	40.7	40.0	27.0	36.9	35.2
PNMR	35.2	32.7	33.0	12.8	39.1	34.6	26.7	25.6	25.8	14.9	21.2	20.0	21.4	29.8	28.4
IMR	60.3	76.5	74.2	47.0	77.4	72.2	32.1	48.1	45.5	52.0	61.9	60.0	48.4	66.7	63.6
CMR	25.1	17.2	18.4	4.3	28.5	24.3	16.0	24.5	23.2	14.9	15.9	15.7	14.6	21.4	20.2
U5MR	85.4	93.7	92.5	51.3	105.9	96.5	48.1	72.6	68.7	66.9	77.9	75.8	63.0	88.1	83.8
CDR	9.8	7.1	7.6	8.4	7.6	7.8	5.1	5.4	5.3	6.5	6.7	6.6			

** Per 1000 population for CDR & per 1000 live births for other indicators*

ENMR *= Early Neonatal Mortality Rate,* ***LNMR*** *= Late Neonatal Mortality Rate,* ***NMR*** *= Neonatal Mortality Rate,*
PNMR *= Post Neonatal Mortality Rate,* ***IMR*** *= Infant Mortality Rate,* ***CMR*** *= Child Mortality Rate,*
U5MR *= Under Five Mortality Rate,* ***CDR*** *= Crude Death Rate*

Table 19: Key mortality indicators by year and altitude, Dabat HDSS site, December 2012

Mortality indicator*	2009			2010			2011			2012			2009-2012		
	H	M	H+M	H	M	H+M	H	M	H+M	H	M	H+M	H	M	H+M
ENMR	35.1	23.6	31.6	26.4	14.6	22.8	8.8	13.6	10.3	36.0	16.4	30.0	27.4	17.2	24.2
LNMR	9.6	9.5	9.5	12.7	19.5	14.7	7.5	13.6	9.4	12.3	4.7	10.0	10.7	11.7	11.0
NMR	44.7	33.1	41.1	39.0	34.1	37.6	16.3	27.2	19.7	48.4	21.1	40.0	38.0	28.9	35.2
PNMR	42.6	11.8	33.0	36.9	29.3	34.6	33.9	8.2	25.8	22.6	14.1	20.0	33.9	16.0	28.4
IMR	87.3	44.9	74.2	75.9	63.4	72.2	50.2	35.3	45.5	71.0	35.1	60.0	71.9	44.8	63.6
CMR	17.0	21.3	18.4	22.2	29.3	24.3	25.1	19.0	23.2	17.5	11.7	15.7	20.2	20.3	20.2
U5MR	104.4	66.2	92.5	98.1	92.7	96.5	75.3	54.3	68.7	88.5	46.8	75.8	92.2	65.1	83.8
CDR	8.4	5.6	7.6	8	7	7.8	5.5	4.9	5.3	7	5.6	6.6			

** Per 1000 population for CDR & per 1000 live births for other indicators*

ENMR = *Early Neonatal Mortality Rate,* ***LNMR*** = *Late Neonatal Mortality Rate,* ***NMR*** = *Neonatal Mortality Rate,*
PNMR = *Post Neonatal Mortality Rate,* ***IMR*** = *Infant Mortality Rate,* ***CMR*** = *Child Mortality Rate,*
U5MR = *Under Five Mortality Rate,* ***CDR*** = *Crude Death Rate*

Migration:
In 2009, a total of 1731 people out-migrated from the HDSS site making the external out-migration rate 38.2 per 1000 population. The external out-migration rate increased to 49.1 in 2012 (Table 20). During the entire four years, the external out-migration rate was 41.3 per 1000 person years. The out-migration rates were the highest among people aged is 20-24 years (96.3 per 1000 person years) followed by 15-19 years (77.2 per 1000 person years), and 25-29 years (57.6 per 1000 person years). The lowest out-migration rates were observed in the age group of 50-64 years and 65 years and above which were 10.7 and 10.9 per 1000 person years, respectively (Table 21). Each year, external out-migration rates were higher among females (Table 22).

Over the entire four years, external out-migration rates were 35.8 per 1000 person years for males and 46.7 per 1000 person years for females. The highest external out-migration rates for both sexes were observed among people aged 20-24 years. In this age group, the external out-migration rates for males was 83.4 per 1000 person years while it was 109.4 per 1000 person years for females. Followed by the age group of 20-24 years, a high rate of external out-migration was seen in the age group of 25-29 years among males which was 62.8 per 1000 person years. On the contrary, the second highest rate of out-migration in females was observed among 15-19 years (104.2 per 1000 person years) (Table 23). External out-migration rates were higher in the urban areas compared to the rural areas across the study years. External out-migration rate in the urban areas decreased from 69.5 per 1000 population in 2009 to 66.5 per 1000 population in 2012.

On the contrary, increased patterns of external out-migration rates were seen over the four years in the rural areas (Table 24). During the entire four years the external out-migration rates were 61.5 per 1000 person years and 35.8 per 1000 person years, respectively for urban and rural areas (Table 25).

The number of external in-migrants increased from 1,158 in 2009 to 1,916 per 1000 population in 2012. Accordingly the external in-migration rates increased from 25.5 per 1000 population in 2009 to 40.5 per 1000 population in 2012 (Table 26).

During the entire four years the external in-migration rate was 31.5 per 1000 person years. The in-migration rates were highest among people aged is 25-29 years (63.6 per 1000 person years), followed by 20-24 years (47.1 per 1000 person years). The lowest in-migration rates were observed in the age group of 50-64 years which was 11.2 per 1000 person years, respectively (Table 27). Each year, external in-migration rates were higher among females compared to males (Table 28). Over the entire four years, external in-migration rates were 26.1 per 1000 person years for males and 36.7 per 1000 person years for females. The highest in-migration rates for both sexes were observed among people aged 25-29 years. In this age group, the external in-migration rates for males was 57.1 per 1000 person years while it was 69.5 per 1000 person years for females. Followed by the age group of 25-29 years, a high rate of external in-migration was seen among the age group of 0-4 years in males which was 48.6 per 1000 person years. On the contrary, the second highest rate of in-migration rate in females was observed among 20-24 years (67.5 per 1000 person years) (Table 29).

External in-migration rates were higher in the urban areas compared to the rural areas across the study years. External in-migration rate in the urban areas increased from 66.3 per 1000 population in 2009 to 92.2 per 1000 population in 2012. It also increased in rural areas from 15.1 per 1000 population in 2009 to 25.6 per 1000 population in 2012 (Table 31). During the entire four years, the external in-migration rates were 76.2 per 1000 person years and 19.3 per 1000 person years, respectively for urban and rural areas (Table 31).

The net migration rates were negative throughout the four surveillance years. It was -1.3 per 1000 population in 2009, -18 per 1000 population in 2010, -0.5 per 1000 population in 2011, and -8.6 per 1000 population in 2012 (Table 32).

Population growth:
Considering births and deaths only, the Natural Growth rates were 2.2 percent in 2009 and 20110, 2.0 percent in 2011, and 2.3 percent in 2012. The net growth rates were less than 2. It was 1.0 percent in 2009, 0.4 percent in 2010, 1.9 percent in 2011 and 1.4 percent in 2012 (Table 32).

Table 20: External out-migration rates (per 1000 mid-year population) by year, Dabat HDSS site, December 2012

Age group	2009			2010			2011			2012		
	No. of people*	Out-mi-grants	ASEOMR	No. of people*	Out-mi-grants	ASEOMR	No. of people*	Out-mi-grants	ASEOMR	No. of people*	Out-mi-grants	ASEOMR
0-4	7,330	201	27.4	7,241	176	24.3	6,863	157	22.9	6,754	188	27.8
5-9	6,515	121	18.6	6,866	145	21.1	6,868	149	21.7	7,225	162	22.4
10-14	6,679	176	26.4	6,466	214	33.1	6,551	195	29.8	6,598	282	42.7
15-19	5,673	444	78.3	5,715	439	76.8	5,622	496	88.2	5,732	601	104.8
20-24	3,824	393	102.8	3,908	423	108.2	4,038	429	106.2	4,141	544	131.4
25-29	2,866	195	68.0	2,889	170	58.8	2,906	148	50.9	3,111	210	67.5
30-49	7,679	148	19.3	7,834	179	22.8	8,106	188	23.2	8,370	252	30.1
50-64	3,240	37	11.4	3,311	38	11.5	3,534	29	8.2	3,616	53	14.7
65+	1,563	16	10.2	1,585	14	8.8	1,690	25	14.8	1,706	30	17.6
Total	**45,369**	**1,731**	**38.2**	**45,815**	**1,798**	**39.2**	**46,178**	**1,816**	**39.3**	**47,253**	**2,322**	**49.1**
CEOMR			**38.2**			**39.2**			**39.3**			**49.1**

** Mia-year populationon June 30*

***ASEOMR** = Age Specific External Out-migration Rate*
*CEOMR = **Crude External Out-migration Rate***

Table 21: External out-migration (per 1000 person years) for the entire period 2009-2012, Dabat HDSS site, December 2013

Age group	Person years	No of out-migrants	ASEOMR
0-4	16528.7	722	43.7
5-9	29457	577	19.6
10-14	26516.4	867	32.7
15-19	25619.7	1979	77.2
20-24	18572.5	1789	96.3
25-29	12554.9	723	57.6
30-49	33835.4	767	22.7
50-64	14606.8	157	10.7
65+	7774.1	85	10.9
Total	185465.6	7666	41.3
CEOMR			41.3

ASEOMR = *Age Specific External Out-migration Rate*

CEOMR = ***Crude External Out-migration Rate***

Table 22: External out migration rates (per 1000 mid-year population) by sex, Dabat HDSS site, December 2012

Age group	2009						2010						2011						2012					
	Male			Female			Male			Female			Male			Female			Male			Female		
	MYP *	Out-migrants	ASEOMR	MYP *	Out-migrants	ASEOMR	MYP *	Out-migrants	ASEOMR	MYP *	Out-migrants	ASEOMR	MYP *	Out-migrants	ASEOMR	MYP *	Out-migrants	ASEOMR	MYP *	Out-migrants	ASEOMR	MYP *	Out-migrants	ASEOMR
0-4	3,675	102	27.8	3,655	99	27.1	3,681	101	27.4	3,560	75	21.1	3,495	81	23.2	3,368	76	22.6	3,431	104	30.3	3,323	84	25.3
5-9	3,311	51	15.4	3,204	70	21.8	3,436	69	20.1	3,430	76	22.2	3,421	60	17.5	3,447	89	25.8	3,613	84	23.2	3,612	78	21.6
10-14	3,346	72	21.5	3,333	104	31.2	3,239	88	27.2	3,227	126	39.0	3,322	69	20.8	3,229	126	39.0	3,335	102	30.6	3,263	180	55.2
15-19	2,768	144	52.0	2,905	300	103.3	2,822	147	52.1	2,893	292	100.9	2,827	153	54.1	2,795	343	122.7	2,925	199	68.0	2,807	402	143.2
20-24	1,896	169	89.1	1,928	224	116.2	1,897	194	102.3	2,011	229	113.9	1,995	166	83.2	2,043	263	128.7	2,019	249	123.3	2,122	295	139.0
25-29	1,266	94	74.2	1,600	101	63.1	1,312	93	70.9	1,577	77	48.8	1,327	73	55.0	1,579	75	47.5	1,439	113	78.5	1,672	97	58.0
30-49	3,727	80	21.5	3,952	68	17.2	3,771	102	27.0	4,063	77	19.0	3,887	97	25.0	4,219	91	21.6	4,004	123	30.7	4,366	129	29.5
50-64	1,499	19	12.7	1,741	18	10.3	1,516	15	9.9	1,795	23	12.8	1,594	11	6.9	1,940	18	9.3	1,631	23	14.1	1,985	30	15.1
65+	849	2	2.4	714	14	19.6	870	6	6.9	715	8	11.2	927	8	8.6	763	17	22.3	925	13	14.1	781	17	21.8
Total	**22,337**	**733**	**32.8**	**23,032**	**998**	**43.3**	**22,544**	**815**	**36.2**	**23,271**	**983**	**42.2**	**22,795**	**718**	**31.5**	**23,383**	**1,098**	**47.0**	**23,322**	**1,010**	**43.3**	**23,931**	**1,312**	**54.8**
CEOMR			**32.8**			**43.3**			**36.2**			**42.2**			**31.5**			**47.0**			**43.3**			**54.8**

** Mia-year populationon June 30*

ASEOMR *= Age Specific External Out-migration Rate*
CEOMR *= Crude External Out-migration Rate*
MYP = Mid Year Populatior

Table 23: External out-migration rates (per 1000 person years) by sex for the entire period 2009-2012, Dabat HDSS site, December 2012

Age group	Male			Female		
	Person years	Out-migrants	ASEOMR	Person years	Out-migrants	ASEOMR
0-4	8418	388	46.1	8110.7	334	41.2
5-9	14714.6	264	17.9	14742.4	313	21.2
10-14	13283.9	331	24.9	13232.5	536	40.5
15-19	12798.3	643	50.2	12821.4	1336	104.2
20-24	9333	778	83.4	9239.5	1011	109.4
25-29	5937.3	373	62.8	6617.6	350	52.9
30-49	16132.1	402	24.9	17703.4	365	20.6
50-64	6587.7	68	10.3	8019.1	89	11.1
65+	4193.6	29	6.9	3580.5	56	15.6
Total	91398.5	3276	35.8	94067	4390	46.7
CEOMR			35.8			46.7

ASEOMR= Age Specific External Out-migration Rate
CEOMR = Crude External Out-migration Rate

Table 24: Out migration rates (per 1000 mid-year population) by residence, Dabat HDSS site, December 2012

Age group	2009						2010						2011						2012					
	Urban			Rural			Urban			Rural			Urban			Rural			Urban			Rural		
	MYP *	Out-migrants	ASEOMR	MYP *	Out-migrants	ASEOMR	MYP *	Out-migrants	ASEOMR	MYP *	Out-migrants	ASEOMR	MYP *	Out-migrants	ASEOMR	MYP *	Out-migrants	ASEOMR	MYP *	Out-migrants	ASEOMR	MYP *	Out-migrants	ASEOMR
0-4	1,173	55	46.9	6,157	146	23.7	1,177	43	36.5	6,064	133	21.9	1,175	35	29.8	5,688	122	21.4	1,281	42	32.8	5,473	146	26.7
5-9	1,045	36	34.4	5,470	85	15.5	1,161	34	29.3	5,705	111	19.5	1,219	45	36.9	5,649	104	18.4	1,275	48	37.6	5,950	114	19.2
10-14	1,251	61	48.8	5,428	115	21.2	1,195	63	52.7	5,271	151	28.6	1,156	55	47.6	5,395	140	25.9	1,214	80	65.9	5,384	202	37.5
15-19	1,324	191	144.3	4,349	253	58.2	1,328	155	116.7	4,387	284	64.7	1,259	160	127.1	4,363	336	77.0	1,301	200	153.7	4,431	401	90.5
20-24	809	138	170.6	3,015	255	84.6	863	112	129.8	3,045	311	102.1	939	113	120.3	3,099	316	102.0	1,072	144	134.3	3,069	400	130.3
25-29	677	75	110.8	2,189	120	54.8	735	52	70.7	2,154	118	54.8	803	41	51.1	2,103	107	50.9	974	68	69.8	2,137	142	66.4
30-49	1,821	62	34.0	5,858	86	14.7	1,906	72	37.8	5,928	107	18.0	1,999	70	35.0	6,107	118	19.3	2,151	95	44.2	6,219	157	25.2
50-64	770	21	27.3	2,470	16	6.5	803	10	12.5	2,508	28	11.2	871	15	17.2	2,663	14	5.3	912	19	20.8	2,704	34	12.6
65+	397	5	12.6	1,166	11	9.4	407	4	9.8	1,178	10	8.5	425	12	28.2	1,265	13	10.3	444	11	24.8	1,262	19	15.1
Total	9,267	644	69.5	36,102	1,087	30.1	9,575	545	56.9	36,240	1,253	34.6	9,846	546	55.5	36,332	1,270	35.0	10,624	707	66.5	36,629	1,615	44.1
CEOMR			**69.5**			**30.1**			**56.9**			**34.6**			**55.5**			**35.0**			**66.5**			**44.1**

** Mia-year populationon June 30*

ASEOMR= Age Specific External Out-migration Rate
CEOMR = Crude External Out-migration Rate
MYP = Mid Year Population

Table 25: External out-migration rates (per 1000 person years) by residence for the entire period 2009-2-12, Dabat HDSS site, December 2012

Age group	Urban			Rural		
	Person years	Out-migrants	ASEOMR	Person years	Out-migrants	ASEOMR
0-4	2981.3	175	58.7	13547.4	547	40.4
5-9	5014.3	163	32.5	24442.8	414	16.9
10-14	4603.1	259	56.3	21913.3	608	27.7
15-19	5569.1	705	126.6	20050.6	1274	63.5
20-24	4202.4	507	120.6	14370.1	1282	89.2
25-29	3366.6	236	70.1	9188.3	487	53
30-49	8442.7	299	35.4	25392.8	468	18.4
50-64	3544.4	65	18.3	11062.3	92	8.3
65+	1971.1	32	16.2	5803	53	9.1
Total	39695.1	2441	61.5	145770.5	5225	35.8
CEOMR			61.5			35.8

ASEOMR = *Age Specific External Out-migration Rate*
CEOMR = *Crude External Out-migration Rate*

Table 26: External In-migration rates (per 1000 mid-year population) by year, Dabat HDSS site, December 2012

Age group	2009			2010			2011			2012		
	No. of people*	No of In-migrants	ASEIMR	No. of people*	No of In-migrants	ASEIMR	No. of people*	No of In-migrants	ASEIMR	No. of people*	No of In-migrants	ASEIMR
0-4	7,330	234	31.9	7,241	186	25.7	6,863	298	43.4	6,754	338	50.0
5-9	6,515	97	14.9	6,866	98	14.3	6,868	198	28.8	7,225	225	31.1
10-14	6,679	150	22.5	6,466	121	18.7	6,551	198	30.2	6,598	215	32.6
15-19	5,673	196	34.5	5,715	147	25.7	5,622	296	52.7	5,732	270	47.1
20-24	3,824	174	45.5	3,908	124	31.7	4,038	266	65.9	4,141	295	71.2
25-29	2,866	115	40.1	2,889	112	38.8	2,906	222	76.4	3,111	259	83.3
30-49	7,679	151	19.7	7,834	144	18.4	8,106	238	29.4	8,370	228	27.2
50-64	3,240	25	7.7	3,311	22	6.6	3,534	51	14.4	3,616	42	11.6
65+	1,563	16	10.2	1,585	20	12.6	1,690	28	16.6	1,706	44	25.8
Total	**45,369**	**1,158**	**25.5**	**45,815**	**974**	**21.3**	**46,178**	**1,795**	**38.9**	**47,253**	**1,916**	**40.5**
CEIMR			**25.5**			**21.3**			**38.9**			**40.5**

** Mia-year populationon June 30*

***ASEIMR** = Age Specific External In-migration Rate*
CEIMR = Crude External In-migration Rate

Table 27: External In-migration (per 1000 person years) for the entire period 2009-2012, Dabat HDSS site, December 2012

Age group	Person years	No of in-migrants	ASEIMR
0-4	16528.7	762	46.1
5-9	29457	750	25.5
10-14	26516.4	600	22.6
15-19	25619.7	864	33.7
20-24	18572.5	874	47.1
25-29	12554.9	799	63.6
30-49	33835.4	911	26.9
50-64	14606.8	164	11.2
65+	7774.1	119	15.3
Total	**185465.6**	**5843**	**31.5**
CEIMR			**31.5**

ASEIMR = *Age Specific External In-migration Rate*
CEIMR = ***Crude External In-migration Rate***

Table 28: External in migration rates (per 1000 mid-year population) by sex, Dabat HDSS site, December 2012

Age group	2009						2010						2011						2012					
	M			F			M			F			M			F			M			F		
	MYP *	In-migrants	ASEIMR	MYP *	In-migrants	ASEIMR	MYP *	In-migrants	ASEIMR	MYP *	In-migrants	ASEIMR	MYP *	In-migrants	ASEIMR	MYP *	In-migrants	ASEIMR	MYP *	In-migrants	ASEIMR	MYP *	In-migrants	ASEIMR
0-4	3,675	117	31.8	3,655	117	32.0	3,681	105	28.5	3,560	81	22.8	3,495	149	42.6	3,368	149	44.2	3,431	184	53.6	3,323	154	46.3
5-9	3,311	40	12.1	3,204	57	17.8	3,436	37	10.8	3,430	61	17.8	3,421	92	26.9	3,447	106	30.8	3,613	108	29.9	3,612	117	32.4
10-14	3,346	43	12.9	3,333	107	32.1	3,239	49	15.1	3,227	72	22.3	3,322	86	25.9	3,229	112	34.7	3,335	77	23.1	3,263	138	42.3
15-19	2,768	36	13.0	2,905	160	55.1	2,822	37	13.1	2,893	110	38.0	2,827	67	23.7	2,795	229	81.9	2,925	81	27.7	2,807	189	67.3
20-24	1,896	59	31.1	1,928	115	59.6	1,897	38	20.0	2,011	86	42.8	1,995	82	41.1	2,043	184	90.1	2,019	106	52.5	2,122	189	89.1
25-29	1,266	45	35.5	1,600	70	43.8	1,312	48	36.6	1,577	64	40.6	1,327	106	79.9	1,579	116	73.5	1,439	120	83.4	1,672	139	83.1
30-49	3,727	66	17.7	3,952	85	21.5	3,771	67	17.8	4,063	77	19.0	3,887	131	33.7	4,219	107	25.4	4,004	122	30.5	4,366	106	24.3
50-64	1,499	10	6.7	1,741	15	8.6	1,516	9	5.9	1,795	13	7.2	1,594	19	11.9	1,940	32	16.5	1,631	17	10.4	1,985	25	12.6
65+	849	5	5.9	714	11	15.4	870	7	8.0	715	13	18.2	927	10	10.8	763	18	23.6	925	12	13.0	781	32	41.0
Total	22,337	421	18.8	23,032	737	32.0	22,544	397	17.6	23,271	577	24.8	22,795	742	32.6	23,383	1,053	45.0	23,322	827	35.5	23,931	1,089	45.5
CEIMR			18.8			32.0			17.6			24.8			32.6			45.0			35.5			45.5

* *Mia-year populationon June 30*

ASEIMR = *Age Specific External In-migration Rate*
CEIMR = *Crude External In-migration Rate*

Table 29: External In-migration (per 1000 person years) by sex for the entire period 2009-2012, Dabat HDSS site, December 2012

Age group	Male			Female		
	Person years	In-migrants	ASEIMR	Person years	In-migrants	ASEIMR
0-4	8418	409	48.6	8110.7	353	43.5
5-9	14714.6	361	24.5	14742.4	389	26.4
10-14	13283.9	232	17.5	13232.5	368	27.8
15-19	12798.3	238	18.6	12821.4	626	48.8
20-24	9333	250	26.8	9239.5	624	67.5
25-29	5937.3	339	57.1	6617.6	460	69.5
30-49	16132.1	453	28.1	17703.4	458	25.9
50-64	6587.7	67	10.2	8019.1	97	12.1
65+	4193.6	38	9.1	3580.5	81	22.6
Total	**91398.5**	**2387**	**26.1**	**94067**	**3456**	**36.7**
CEIMR			**26.1**			**36.7**

ASEIMR = *Age Specific External In-migration Rate*
CEIMR = ***Crude External In-migration Rate***

Table 30: External in-migration rates (per 1000 mid-year population) by residence, Dabat HDSS site, December 2012

Age group	2009						2010						2011						2012					
	Urban			Rural			Urban			Rural			Urban			Rural			Urban			Rural		
	MYP*	In-migrants	ASEIMR	MYP*	In-migrants	ASEIMR	MYP*	In-migrants	ASEIMR	MYP*	In-migrants	ASEIMR	MYP*	In-migrants	ASEIMR	MYP*	In-migrants	ASEIMR	MYP*	In-migrants	ASEIMR	MYP*	In-migrants	ASEIMR
0-4	1,173	101	86.1	6,157	133	21.6	1,177	81	68.8	6,064	105	17.3	1,175	124	105.5	5,688	174	30.6	1,281	135	105.4	5,473	203	37.1
5-9	1,045	40	38.3	5,470	57	10.4	1,161	41	35.3	5,705	57	10.0	1,219	93	76.3	5,649	105	18.6	1,275	88	69.0	5,950	137	23.0
10-14	1,251	79	63.1	5,428	71	13.1	1,195	63	52.7	5,271	58	11.0	1,156	112	96.9	5,395	86	15.9	1,214	106	87.3	5,384	109	20.2
15-19	1,324	99	74.8	4,349	97	22.3	1,328	65	48.9	4,387	82	18.7	1,259	126	100.1	4,363	170	39.0	1,301	142	109.1	4,431	128	28.9
20-24	809	103	127.3	3,015	71	23.5	863	72	83.4	3,045	52	17.1	939	169	180.0	3,099	97	31.3	1,072	175	163.2	3,069	120	39.1
25-29	677	75	110.8	2,189	40	18.3	735	70	95.2	2,154	42	19.5	803	143	178.1	2,103	79	37.6	974	161	165.3	2,137	98	45.9
30-49	1,821	94	51.6	5,858	57	9.7	1,906	71	37.3	5,928	73	12.3	1,999	136	68.0	6,107	102	16.7	2,151	131	60.9	6,219	97	15.6
50-64	770	15	19.5	2,470	10	4.0	803	14	17.4	2,508	8	3.2	871	31	35.6	2,663	20	7.5	912	20	21.9	2,704	22	8.1
65+	397	8	20.2	1,166	8	6.9	407	10	24.6	1,178	10	8.5	425	11	25.9	1,265	17	13.4	444	22	49.5	1,262	22	17.4
Total	**9,267**	**614**	**66.3**	**36,102**	**544**	**15.1**	**9,575**	**487**	**50.9**	**36,240**	**487**	**13.4**	**9,846**	**945**	**96.0**	**36,332**	**850**	**23.4**	**10,624**	**980**	**92.2**	**36,629**	**936**	**25.6**
CEIMR			**66.3**			**15.1**			**50.9**			**13.4**			**96.0**			**23.4**			**92.2**			**25.6**

** Mia-year populationon June 30*

ASEIMR = *Age Specific External In-migration Rate*
CEIMR = *Crude External In-migration Rate*
MYP = Mid Year Populatio

Table 31: External In-migration rates (per 1000 person years) by residence for the entire period 2009-2012, Dabat HDSS site, December 2012

Age group	Urban			Rural		
	Person years	In-migrants	ASEIMR	Person years	In-migrants	ASEIMR
0-4	2981.3	316	106	13547.4	446	32.9
5-9	5014.3	313	62.4	24442.8	437	17.9
10-14	4603.1	308	66.9	21913.3	292	13.3
15-19	5569.1	407	73.1	20050.6	457	22.8
20-24	4202.4	489	116.4	14370.1	385	26.8
25-29	3366.6	529	157.1	9188.3	270	29.4
30-49	8442.7	515	61	25392.8	396	15.6
50-64	3544.4	89	25.1	11062.3	75	6.8
65+	1971.1	60	30.4	5803	59	10.2
Total	**39695.1**	**3026**	**76.2**	**145770.5**	**2817**	**19.3**
CEIMR			**76.2**			**19.3**

ASEIMR = *Age Specific External In-migration Rate*
CEIMR = *Crude External In-migration Rate*

Table 32: Population growth rates by year, Dabat HDSS site, December 2012

Event	Indicator	2009	2010	2011	2012
Birth	**No. of births**	1,362	1,358	1,165	1,399
	CBR per 1000	30.0	29.6	25.2	29.6
External In-migration	**Number**	1,158	974	1,795	1,916
	CEIMR per 1000	25.5	21.3	38.9	40.5
External out- migration	**Number**	1,731	1,798	1,816	2,322
	CEOMR per 1000	38.2	39.2	39.3	49.1
Net external migration	**Number**	-573	-824	-21	-406
	NEMR per 1000	-1.3	-18	-0.5	-8.6
Death	**Number**	347	356	247	313
	CDR per 1000	7.6	7.8	5.3	6.6
Rate of Natural Increase (RNI)	**Rate per 100**	2.2	2.2	2	2.3
Net growth rate	**Rate per 100**	1	0.4	1.9	1.4

DISCUSSION

The population of Dabat Health and Demographic and Health Surveillance site increased from 45,369 in 2009 to 47, 253 in 2012. The natural growth rates were almost the same in the 2 surveillance years, 2.2 percent in 2009 and 2.3 percent in 2012. The natural growth rate of 2009 was higher than the annual growth rate reported for the Amhara Region in 2007 which was 1.7 percent but lower than what was reported for the country as a whole (2.6%)(1). The net growth rates were lower than the crude rates of natural increase in all the surveillance years due to high rates of external out-migration. Since most people in the surveillance area live in rural areas, people might have migrated to major urban settings for different reasons like college education, employment etc.

In 2009 males constituted about 49.3% of the total population which was a little bit lower than the census report for the country (50.5%) but similar to the finding of the 2008 re-census finding (49.0%) in the surveillance area(1, 6). Different sex compositions had been observed at different ages of the population. The percentage of males during the first year of life was 51.26% in 2012. The percentage decreased to 44.9% at the age of 30-34 years. On the other hand, males significantly outnumbered the females at the age of 65 years and above when they constituted 54.2% of the total population. This sex composition was similar to what was reported in the 2007 population and housing census of Ethiopia(1).

The percentage of the under-five year population was lower in 2012 (14.3%) compared to the percentage in 2009 (16.2%). In line with this, the child dependency ratio decreased from 88.2 in 2009 to 82.4 in 2012. On the contrary, old age dependency ratio slightly increased from 6.7 in 2009 to 6.8 in 2009. A similar trend was observed in the country where the proportion of the young population of under 15 has declined from 49.8% in 1984 to 45.0% in 2007(1). This may be attributed to the increased rate of contraceptive use in the country at large(2)

According to the 2011 DHS(2), the CBR in Ethiopia was 34.5 births per 1,000 population. There was a substantial difference in CBR between urban (26 per 1,000 population) and rural (36 per 1,000 population) residences. The CBR in the Dabat surveillance area (25.2 in 2011) was lower than what was reported for the country in 2011. Like that of the country report, the urban rural differences were also observed in the surveillance area where the CBR in 2011 was 19.0 in the urban area and 26.9 in the rural area. In the surveillance sites, the ASFR among adolescents of age 15-19 years was 59.0 per 1,000 women of age 15-19 years in 2011 which was lower than the 2011 DHS report (79 per 1000). High ASFR (*178.0* per 1,000 women*)* was observed in the age interval of 25-29 which was similar to the EDHS report of 2010/11 (241 per 1,000 women). The TFR was 4.7 during the 2008 re-census and decreased to 4.2 in 2012. This TFR of 4.2 is in agreement with the 2011 report of the DHS which reported 4.0. The TFR in rural areas exceeds the TFR in urban areas which is congruent with other reports(2, 13). The GFR was 109.5 live births per 1,000 women of reproductive age in 2011 which was lower than the GFR of the country (161 live births per 1,000 women of reproductive age) in 2011(2).

The CDR in 2012 (6.6 per 1000 population) was lower than it was in 2009 (7.6 per 1000). Death rates were highest among children of under-five years which is common in developing countries where acute lower respiratory infections, diarrhoea, malaria, measles, HIV/AIDS, pre-term birth, birth asphyxia are the leading causes of death(14-18). When the entire period from 2009 to 2012 was considered, the average Early Neonatal, Neonatal, Infant, and Under-five mortality rates were 24.2, 35.2, 63.3 and 83.8 per 1000 live births, respectively. According to the EDHS 2011 report, neonatal, post-neonatal, infant, child, and under-five mortality rates were 37.0, 22.0, 59.0, 31.0, and 88.0 per 1000 live births, respectively (2). This indicates that the post neonatal and infant mortality rates were higher in Dabat district compared to the 2011 DHS report for the country.

Also as reported in the 2011 DHS(2), compared to urban areas, childhood mortality rates for the entire period 2009 to 2012 were higher in the rural areas. Except the late neonatal mortality, all other childhood mortality rates showed reduction from the rates of 2009. For example, IMR decreased from 74.2 in 2009 to 60.0 in 2012. Similarly, Under-five Mortality Rate decreased from 92.5 in 2009 to 75.0 in 2012. Though there is reduction, a further strengthening of efforts is required to achieve Millennium Development Goal 4 which is about reducing child mortality (19). For almost all indicators of crude and childhood mortalities, higher rates were observed in highlands than in midlands. The reasons for such differences need further investigation.

Negative net migration rates were reported during the entire 4 years which ranged from -1.3 per 1000 popu-

lation in 2009 to -8.6 per 1000 population in 2012. This negative migration rate is in line with what was reported for the country as a whole in 1994(12). One of the reasons for the high rate of out migration of people could be the rural nature of most of the surveillance areas where people may migrate to major urban settings for different reasons, like college education, employment etc. Additionally, people from the rural areas may migrate to more fertile lands for their livelihood. Both in-migration and out-migration rates were higher in the urban areas compared to the rural areas across the study years. This may be attributed to the nature of urban areas where movement to and from the areas is high for different reasons(20). The in-migration rate was high in the age group of 25 -29 years while the out-migration rate was high in the age group of 20-24 years. This shows that, as expected, migration rates are higher among young adults where people migrate for reasons, like marriage, further education in urban settings, seeking jobs etc. a similar finding was reported in Butajira that most migrants were in their twenties(21). Similar to the 1994 census report for the Amhara Region(20), and the finding in Butajira(21), both out and in-migration rates were high among females. One of the reasons for this higher rate of migration among women can be marriage which requires the women to move to the place where the husband lives.

Limitations of the surveillance:

The following can be considered as limitations

1. The surveillance population was relatively small which might have led to less precision in estimating the parameters
2. Recall bias might have affected the report as surveillance data is collected every 6 months
3. Especially during the first 2 years after the re-census, movement of an individual for a short period of time was registered as migration. This might have inflated the number of external in and out-migrants.
4. Two kebeles included in the surveillance (Bera and Arebur) are so remote making supervision by the research team difficult

Conclusion and recommendation:

While the decreases in fertility rates were not remarkable, there were substantial reductions in childhood mortality rates. The net external migration rates were negative over the entire surveillance period. Based on the findings, the following recommendations are forwarded

1. Expand the surveillance to other kebeles so as to increase the number of people under surveillance. It is good to consider the inclusion of more urban and lowland kebeles in the surveillance
2. The District Health Office and the health institutions in the area with other stake-holders need to maximize their curative, preventive, and promotive health services to significantly reduce the fertility and mortality rates.
3. Conduct update round visits every 3 months to minimize recall biases
4. Detailed study on the reasons for migration especially out-migration.

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REFERENCES

1. Summary and Statistical Report of the 2007 Population and Housing Census. Federal Democratic Republic of Ethiopia, Population Census Commission., December 2008.
2. Ethiopia Demographic and Health Survey 2011. Central Statistical Agency, ICF International, March 2012.

3. Health and Health and Health Related Indicators. Federal Democratic Republic of Ethiopia, Ministry of Health, 2003 E.C/ 2011 G.C.
4. Berhane Y, Wall S, Kebede D, Emmelin A, Enquisilassie F, Byass P, et al. Establishing an epidemiological field laboratory in rural areas-potentials for public health research and interventions: The Butajira Rural Health 1987-99 Program. Ethiop J Health Dev. 1999;13(Supp):1 -47.
5. Araya T, Reniers G, Schaap A, Kebede D, Kumie A, Nagelkerke N, et al. Lay diagnosis of causes of death for monitoring AIDS mortality in Addis Ababa, Ethiopia. Tropical Medicine and International Health. Jan 2004;9(1):178–86.
6. Tadesse T, Getachew A, Admassu M, Kebede Y, Awoke T, Melese T, et al. Demographic and Health Survey at Dabat District in Northwest Ethiopia: Report of the 2008 baseline survey. Ethiopian Journal of Health and Biomedical Sciences. Sept 2014;4(Special issue).
7. Deribew A, Tessema F, Girma B. Determinants of under-five mortality in Gilgel Gibe FieldResearch Center, Southwest Ethiopia. EthiopJHealth Dev. 2007;21(2):117-24.
8. Gobena T, Berhane Y, Worku A. Low long-lasting insecticide nets (LLINs) use among household members for protection against mosquito bite in kersa, Eastern Ethiopia. BMC Public Health. 2012;12:914.
9. Woldearegawi B, Ashebir Y, Gebeye E, Gebregziabiher T, Yohannes M, Mussa S, et al. Emerging chronic non-communicable diseases in rural communities of Northern Ethiopia: evidence using population-based verbal autopsy method in Kilite Awlaelo surveillance site. Health Policy and Planning. 2013:1-8.
10. cmhs. Research. Arba Minch University. College of Medicine and Health Sciences; 2015 [cited 2013 10 December]; Available from: http://www.amu.edu.et.
11. Fantahun M, Kumbi S, Degu G, Kebede Y, Admassu M, Haile W, et al. Dabat Rural Health Project, Northwest Ethiopia, Report of the baseline survey. EthiopJHealth Dev. 2001;15(Special issue).
12. Migration and Remittances. Fact Book 2011. Second edition. The World Bank; 2011.
13. Ethiopia Demographic and Health Survey 2005. Central Statistical Agency, 2006.
14. Thaver D, Zaidi A. Burden of neonatal infections in developing countries: a review of evidence from community-based studies. Pediatr Infect Dis J. 2009;28(Suppl).
15. Neonatal and Perinatal Mortality.Country, Regional and Global estimates 2004. World Health Organization, 2007.
16. Rajaratnam J, Marcus J, Flaxman A, Wang H, Levin-Rector A, Dwyer L, et al. Neonatal, postneonatal, childhood, and under-5 mortality for 187 countries, 1970-2010: a systematic analysis of progress towards Millennium Development Goal 4. Lancet. 2010;375(9730):1988-2008.
17. Rudan I, O'Brien K, Nair H, Liu L, Theodoratou E, Qazi S, et al. Epidemiology and etiology of childhood pneumonia in 2010: estimates of incidence, severe morbidity, mortality, underlying risk factors and causative pathogens for 192 countries. J Glob Health. 2013;3(1):10401.
18. Rudan I, Nair H, Marušic A, Campbell H. Reducing mortality from childhood pneumonia and diarrhoea: The leading priority is also the greatest opportunity. J Glob Health. 2013;3(1):10101.
19. Ethiopia: 2010 MDGs Report. Trends and prospects for meeting MDGs by 2015. Ministry of Finance and Economic Development Federal Democratic Republic of Ethiopia, 2010.
20. The 1994 Population and Housing Census of Ethopia. Results for Amhara Region. Volume II Analytical Report. Office of Population and Housing Census Commission, Central Statistical Authority, 1998.
21. Byass P, Berhane Y, Emmelin A, Wall S. Patterns of local migration and their consequences in a rural Ethiopian population. Scand J Public Health. 2003;31:58.